1/31/05 - 00287

Risk Management of Groundwater at Site 3, St. Juliens Creek Annex (SJCA), Chesapeake, Virginia

PREPARED FOR: SJCA Project Management Team

PREPARED BY: Kim Henderson/CH2M HILL

DATE: January 31,2005

This memorandum summarizes the potential risks identified and risk management conclusions for shallow and deep groundwater at Site 3. The potential risks to human and ecological receptors posed by media at Site 3 were identified in the *Final Remedial Investigation/Human Health Risk Assessment/Ecological Risk Assessnzeizt (RI/HHRA/ERA) Report for Sites 3, 4, 5, and* 6 (CH2M HILL, March 2003). The monitoring well locations at Site 3 are shown on Figure 1.

Shallow Groundwater (Columbia Aquifer)

Shallow groundwater is not considered a regional potable water source at or in the vicinity of SJCA due to its poor quality and low yield. Human health risks were evaluated for a construction worker scenario based on dermal contact and incidental ingestion only, and the results were below the Environmental Protection Agency's (EPA's) acceptable risk ranges ($1x10^{-4}$ to $1x10^{-6}$ for carcinogens and Hazard Index of 1 for noncarcinogens).

Concentrations of one semivolatile organic compound (SVOC), bis(2-ethylhexyl)phthalate, and one inorganic analyte, thallium, exceeded their respective Maximum Contaminant Levels (MCLs) in shallow groundwater (Table 1). However;

- Bis(2-ethylhexyl)phthalate was detected in 1997 at a concentration (25 µg/L) above the MCL (6 µg/L) and the background upper tolerance limit (UTL) (1 µg/L) at only one monitoring well (SJS03-MW04S) and was not detected in subsequent monitoring rounds. Bis(2-ethylhexyl)phthalate is a known potential lab contaminant that likely reflects artifacts of the analytical process.
- Thallium was only detected at one monitoring well (SJS03-MW06S) and although the concentration (5.60 L µg/L) was above the MCL (2 µg/L), it was below the background UTL (7.6 µg/L). Additionally, a duplicate sample was collected at this location in which thallium was not detected. Therefore, thallium detected in shallow groundwater at Site 3 is not considered to be site-related.

Based on the discussion above, the shallow groundwater meets the MCLs in the latest round of sampling collected from Site 3 in 1999. Additionally, the SJCA Project Management Team (Navy, EPA, VDEQ) determined the previous MCL exceedances in shallow groundwater at Site 3 be anomalous and acceptable.

There is also the potential for groundwater from the Columbia Aquifer at Site 3 to discharge to sediment and surface water in the site drainages during high groundwater table

conditions. This exposure pathway was evaluated for potential ecological risks to aquatic life. Although several chemicals were identified as a potential concern in drainage surface water and sediment/soil that were also detected in groundwater, elevated concentrations of these chemicals were also detected in site soils. Based on the proximity of these media to one another, it is likely that surface soils represent the primary source of chemicals to the site drainages and this pathway was mitigated by the removal of waste, soil, and upland drainage sediment/soil at Site 3. Thus, groundwater does not appear to be a significant transport route from the site to the drainages.

Deep Groundwater (Yorktown Aquifer)

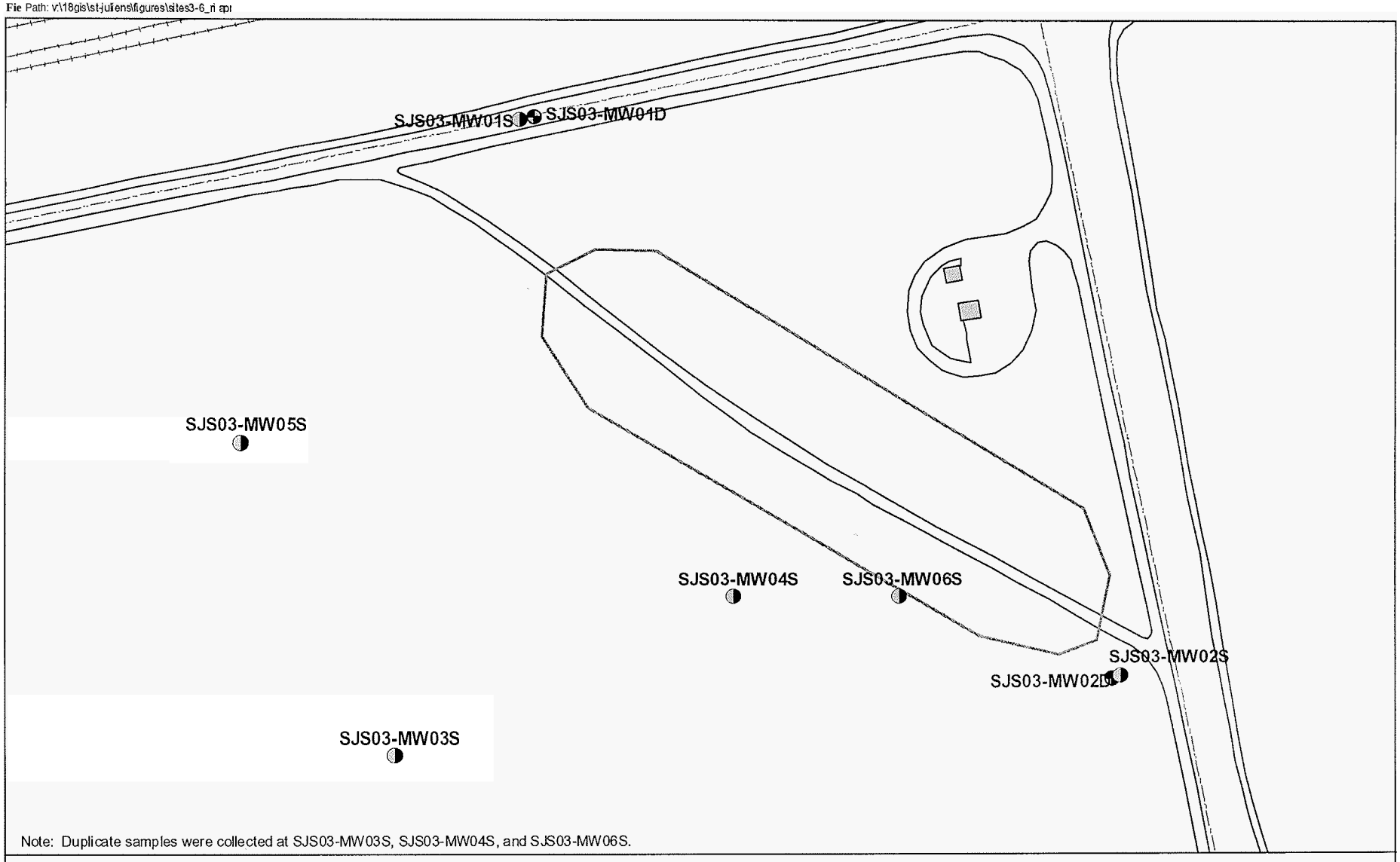
In the area of SJCA, the deep groundwater is not used as a potable water supply. Area residences are only located upgradient of Site 3 and are supplied potable water by the City of Chesapeake. Deep aquifer groundwater is currently only used for irrigation upgradient of SJCA. Although future residential development of the site is improbable, deep groundwater was evaluated under the future residential scenario. Table 2 shows the deep groundwater data collected at Site 3.

Potential noncarcinogenic hazards (based on ingestion of arsenic, manganese, and thallium) and carcinogenic hazards (based on contact with arsenic) were identified to current and future adult and child residents who use the deep groundwater beneath Site 3 as a potable water supply. However;

- Arsenic was only detected in one unfiltered sample in the upgradient monitoring well (SJS03-MW01D) at an estimated concentration (4.20 J µg/L) below the MCL (10 µg/L).
- Manganese concentrations (ranging from 45.6 µg/L to 612 µg/L) were low and below the tap water risk-based concentration (RBC) of 730 µg/L.
- Thallium was only detected in a 1997 sample at an estimated concentration (2.7 J µg/L) slightly above the MCL (2 µg/L) from the upgradient monitoring well (SJS03-MW01D) and not detected in the subsequent monitoring events.

Based on the discussion above, the deep groundwater meets the MCLs in the latest round of sampling collected from Site 3 in 1999. Additionally, the SJCA Project Management Team (Navy, EPA, VDEQ) determined the deep groundwater risks identified at Site 3 to be acceptable for all pathways and receptors.

File Path: v:\18gis\st-juliens\figures\sites3-6_ri ap



LEGEND

- Monitoring Wells - **Deep**
- Monitoring Wells - Shallow
- IR Sites
- Buildings
- Roads
- Railroads
- Activity Boundary

80 0 80 160 **Feet**

Figure 1
Site 3 Monitoring Well Locations
St. Juliens Creek Annex
Chesapeake, Virginia

CHZMHILL

Table 1
Shallow Groundwater Exceedances of Screening Criteria
at Site 3

	Screening Criteria			SJS03-MW01S			SJS03-MW02S			SJS03-MW03S				SJS03-MW04S				SJS03-MW05S	SJS03-MW06S	
Station ID	RBC-Tap (10/02)	MCL-Ground water	Background UTLs	SJS03-GW01S-001	SJS03-GW01S-002	SJS03-GW01S-003	SJS03-GW02S-001	SJS03-GW02S-002	SJS03-GW02S-003	SJS03-GW03S-001	SJS03-GW03S-001P	SJS03-GW03S-002	SJS03-GW03S-003	SJS03-GW04S-001	SJS03-GW04S-002	SJS03-GW04S-002P	SJS03-GW04S-003	SJS03-GW05S-001	SJS03-GW06S-001	SJS03-GW06S-001P
Sample ID																				
Sample Date				07/17/97	11/04/97	05/20/99	07/17/97	11/04/97	05/19/99	07/21/97	07/21/97	11/04/97	05/19/99	07/17/97	11/04/97	11/04/97	05/19/99	05/19/99	05/19/99	05/19/99
Chemical Name																				
VOCs (UG/L)																				
Acetone	610	--	305	24	NA	NA	8	5 U	NA	5 U	5 J	10	NA	5 U	5 U	5 U	NA	NA	17	17 3
Ethylbenzene	3 3	700	0 6	0 6 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Toluene	750	1,000	0 2	0 2 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Xylene, total	12,000	10,000	1	1	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
SVOCs (UG/L)																				
2-Methylnaphthalene	120	--	2 6	1 J	10 U	11 U	10 U	10 U	11 U	10 U	10 U	10 U	11 U	10 U	10 U	10 U	11 U	11 U	10 U	11 U
4-Methylphenol	180	--	ND	10 U	10 U	11 U	10 U	10 U	11 U	10 U	10 U	10 U	11 U	10 U	10 U	10 U	11 U	11 U	*2 J*	*2 J*
Acenaphthene	370	--	15	15	4 J	3 J	10 U	10 U	11 U	2 J	2 J	7 J	3 J	10 U	10 U	10 U	11 U	11 U	10 U	11 U
Carbazole	3 3	--	2	2 J	10 U	11 U	10 U	10 U	11 U	10 U	10 U	10 U	11 U	10 U	10 U	10 U	11 U	11 U	10 U	11 U
Dibenzofuran	24	--	8	8 J	1 J	11 U	10 U	10 U	11 U	10 U	10 U	10 U	11 U	10 U	10 U	10 U	11 U	11 U	10 U	11 U
Fluoranthene	1,500	--	1	10 U	1 J	11 U	10 U	10 U	11 U	10 U	10 U	10 U	11 U	10 U	10 U	10 U	11 U	11 U	10 U	11 U
Fluorene	240	--	9	9 J	10 U	11 U	10 U	10 U	11 U	10 U	10 U	10 U	11 U	10 U	10 U	10 U	11 U	11 U	10 U	11 U
Naphthalene	6 5	--	15	10	10 U	11 U	10 U	10 U	11 U	10 U	10 U	10 U	11 U	10 U	10 U	10 U	11 U	11 U	10 U	11 U
Phenanthrene	180	--	8 6	6 J	10 U	11 U	10 U	10 U	11 U	10 U	10 U	10 U	11 U	10 U	10 U	10 U	11 U	11 U	10 U	11 U
Phenol	11,000	--	ND	10 U	10 U	11 U	10 U	10 U	11 U	10 U	10 U	10 U	11 U	10 U	10 U	10 U	11 U	11 U	*2 J*	*2 J*
bis(2-Ethylhexyl)phthalate	4 8	6	1	10 U	10 U	1 J	10 U	10 U	11 U	10 U	*2 J*	10 U	11 U	25	14 B	7 B	11 U	11 U	10 U	11 U
Pest/PCBs (UG/L)																				
HeptaclNor	0 015	0 4	ND	0 05 U	0 05 U	0 0520 U	0 05 U	0 05 U	*0 0240 J*	0 05 U	0 05 U	0 05 U	0 0570 U	0 05 U	0 05 U	0 05 U	0 0570 U	0 0520 U	0 0520 U	0 0520 U
Total Metals (UG/L)																				
Aluminum	37,000	--	1,710	*4,100 K*	1,710	395	*19,200 K*	*7,660*	*6,850*	*4,460 K*	*8,270 K*	38 1 U	186 B	*9,170 K*	568 J	38 1 U	247 B	621	92 7 B	55 6 B
Antimony	15	6	2 3	2 2 B	2 3 J	2 70 U	2 U	1 7 U	2 70 U	2 U	2 U	1 7 U	2 70 U	2 U	1 7 U	1 7 U	2 70 U	2 70 U	2 70 U	2 70 U
Arsenic	0 045	10	5	4 4 J	3 2 U	3 40 U	3 U	3 4 J	4 70 J	3 U	3 U	3 2 U	2 U	3 U	3 2 U	3 2 U	2 U	5 10 J	5 80 J	4 10 J
Barium	2,600	2,000	77 1	*176 J*	31 1 J	23 1 J	76 6 J	24 7 J	26 6 J	43 J	47 6 J	16 1 J	12 6 J	51 4 J	20 7 J	20 7 J	21 3 J	*121 J*	*142 J*	*147 J*
Beryllium	73	4	1 4	1 4 J	0 76 J	0 100 U	1 U	*4 J*	*2 J*	1 U	1 U	0 96 J	0 100 U	1 4 J	0 96 J	1 2 J	0 420 J	0 100 U	0 100 U	0 100 U
Cadmium	18	5	0 74	0 5 U	0 4 U	0 420 J	0 5 U	0 4 U	*1 10 J*	0 5 U	0 5 U	0 4 U	0 300 U	0 5 U	0 4 U	0 4 U	0 300 U	0 350 J	0 450 J	0 360 J
Calcium	--	--	531,000	100,000	92,000	141,000	366,000	*488,000*	*529,000*	89,700	95,900	367,000	201,000	176,000	130,000	129,000	156,000	194,000	226,000	212,000
Chromium	110	100	3 2	16 1 B	12 B	3 20 J	56 7	4 6 U	3 10 J	13 8 B	18 3 B	4 6 U	1 10 U	*35 2*	4 6 U	4 6 U	1 10 U	1 60 J	1 10 U	1 10 U
Cobalt	730	--	15	8 5 J	8 8 J	2 30 J	*16 J*	*50 7*	*16 6 J*	8 U	8 U	6 U	0 5 U	8 U	*38 5 J*	*36 8 J*	6 10 J	6 10 J	0 590 B	1 20 B
Copper	1,500	1,300	6 3	7 4 B	6 3 J	5 20 B	15 9 B	5 8 U	7 B	6 8 B	7 8 B	5 8 U	4 10 B	*9 J*	5 8 U	5 8 U	3 40 B	10 6 B	5 5 J	4 60 J
Iron	11,000	--	107,000	31,900	26,200	34,800	33,900	10,400	35,300	32,900	35,000	45,600	24,600	16,400	20,100	20,000	20,600	26,400	28,400	16,100
Lead	15	15	3 9	2 4 B	3 5	2 30 J	*9*	1 3 U	1 90 J	2 6 J	*4 3*	1 7 J	1 40 J	*5 7*	1 4 J	1 3 U	1 U	1 U	1 U	1 U
Magnesium	--	--	296,000	115,000	34,800	31,600	179,000	168,000	179,000	75,300	77,000	33,600	15,000	154,000	48,900	48,700	54,200	126,000	*210,000*	*200,000*
Manganese	730	--	13,700	2,000	1,720	1,770	2,990	6,310	5,440	830	660	2,960	1,600	1,030	1,320	1,320	1,440	2,610	1,850	1,440
Nickel	730	--	20 1	7 U	14 5 J	4 J	*25 1 J*	*84 8*	21 J	7 U	7 U	6 3 U	0 900 U	7 U	*46 1*	*43 1*	5 J	7 90 J	1 70 J	1 60 J
Potassium	--	--	85,400	37,300	26,600	27,100	61,100	25,100	35,400	30,200	31,000	23,000	13,900	57,000	28,200	27,600	31,000	33,600	83,400	81,300
Selenium	180	50	ND	3 U	3 3 U	2 60 U	3 U	*3 3 K*	2 60 U	3 U	3 U	3 3 U	2 60 U	3 U	3 3 U	3 3 U	2 60 U	2 60 U	3 20 B	2 60 U
Silver	180	--	1 1	1 9 J	1 1 U	0 900 U	1 U	1 1 U	0 900 U	1 4 B	1 U	1 3 J	0 900 U	2 3 B	1 7 J	*2 J*	0 900 U	0 900 U	0 900 U	0 900 U
Sodium	--	--	810,000	810,000	122,000	132,000	612,000	298,000	376,000	470,000	468,000	39,400	20,800	799,000	165,000	164,000	182,000	*1,080,000*	*1,660,000*	*1,740,000*
Thallium	2 6	2	7 6	4 6 B	3 1 B	3 20 U	2 U	1 5 U	3 20 UL	2 8 B	2 4 B	1 5 U	3 20 UL	2 U	1 5 U	1 5 U	3 20 UL	3 20 UL	3 60 UL	3 20 UL
Vanadium	260	--	13 7	13 7 J	12 2 J	1 5 J	*42 J*	6 8 U	0 600 U	*18 5 J*	*22 7 J*	6 8 U	0 600 U	*15 5 J*	6 8 U	6 8 U	0 600 U	0 810 J	0 650 J	0 600 U
Zinc	11,000	--	241	35 3 B	55 2 B	241	90	*397*	46 9	20 8 B	22 B	15 6 B	6 40 J	36 4 B	*327*	*327*	28 5	13 8 J	1 90 U	1 90 U
Dissolved Metals (UG/L)																				
Aluminum	37,000	--	395	44 U	64 2 B	67 1 B	*44 U*	*807*	116 B	149 B	164 B	38 1 U	39 2 U	44 U	38 1 U	38 1 U	161 B	70 8 B	50 1 B	44 1 B
Antimony	15	6	3 8	2 U	3 8 J	2 70 U	2 U	1 7 U	2 70 U	2 U	2 U	1 7 U	2 70 U	2 U	1 7 U	1 7 U	2 70 U	2 70 U	2 70 U	2 70 U
Arsenic	0 045	10	2 4	3 U	3 2 U	2 40 U	3 U	3 2 U	2 30 J	3 U	3 U	3 2 U	2 U	3 U	3 2 U	3 2 U	2 U	6 J	6 5 J	5 10 B
Barium	2,600	2,000	93 3	*285*	26 J	21 4 J	43 4 J	25 J	24 J	37 6 J	*44 3 J*	14 9 J	10 5 J	38 J	23 6 J	22 1 J	21 3 J	*113 J*	*175 J*	*161 J*
Beryllium	73	4	0 3	1 U	0 58 U	0 100 U	1 U	*1 9 J*	0 100 U	1 U	1 U	0 58 U	0 100 U	1 U	*1 7 J*	*1 7 J*	*0 510 J*	0 100 U	0 100 U	0 100 U
Cadmium	18	5	0 78	0 5 U	0 4 U	0 330 J	0 5 U	0 49 J	0 540 J	0 5 U	0 5 U	0 4 U	0 300 U	0 5 U	0 4 U	0 4 U	0 300 U	0 450 J	*0 900 J*	0 560 J
Calcium	--	--	464,000	148,000	93,500	132,000	348,000	*524,000*	*513,000*	87,500	98,200	340,000	202,000	178,000	139,000	133,000	150,000	154,000	223,000	196,000
Chromium	110	100	5 8	7 U	5 8 J	1 60 J	7 U	4 6 U	1 10 U	9 2 B	12 5 B	4 6 U	1 10 U	7 U	4 6 U	4 6 U	1 10 U	1 40 J	1 50 J	2 5 J
Cobalt	730	--	15	8 U	7 7 J	2 10 J	12 2 J	*63*	*16 1 J*	8 U	8 U	6 U	0 5 U	8 U	*42 9 J*	*41 8 J*	7 J	4 30 J	0 5 U	0 5 U
Iron	11,000	--	64,000	24,600	24,900	31,900	10,900	20,000	34,000	30,600	33,600	42,200	24,100	6,990	21,400	20,700	20,100	38,000	42,300	42,100
Lead	15	15	2 1	1 U	1 9 B	1 U	1 U	1 4 J	1 U	1 U	1 U	1 3 U	1 U	1 U	1 3 U	1 3 U	1 U	1 U	1 50 J	1 U
Magnesium	--	--	266,000	194,000	35,400	32,900	170,000	163,000	169,000	77,800	86,800	31,500	15,000	150,000	52,500	50,600	51,700	131,000	*333,000*	*292,000*
Manganese	730	--	11,600	3,070	1,750	1,790	2,770	5,710	5,150	800	911	2,760	1,490	1,020	1,420	1,370	1,400	2,910	1,760	1,540
Nickel	730	--	13 2	7 U	8 3 B	3 10 J	7 U	*68 1*	*27 1 J*	7 U	7 U	6 3 U	0 900 U	7 U	*50 5*	*45 7*	7 5 J	7 20 J	1 5 J	2 80 B
Potassium	--	--	73,300	38,900	27,000	28,400	57,200	27,100	33,100	30,800	34,600	21,400	13,500	56,000	30,300	29,000	29,900	29,600	*85,100*	*75,000*
Selenium	180	50	ND	3 U	3 3 U	2 60 U	3 U	*4 3 J*	2 60 U	3 U	3 U	3 3 U	2 60 U	3 U	3 3 U	3 3 U	*4 5 J*	2 60 U	2 60 U	3 90 B
Silver	180	--	2 4	2 4 J	1 6 B	0 900 U	1 U	1 1 U	0 900 U	1 2 B	1 U	2 B	0 900 U	1 U	1 6 B	2 7 B	0 900 U	0 900 U	0 900 U	0 900 U
Sodium	--	--	682,000	*1,530,000*	125,000	141,000	*587,000*	307,000	362,000	525,000	557,000	38,700	29,200	*793,000*	168,000	161,000	172,000	*1,170,000*	*2,120,000*	*1,980,000*
Vanadium	260	--	7 1	9 U	7 1 J	1 20 J	9 U	6 8 U	0 600 U	9 U	9 U	6 8 U	0 600 U	9 U	6 8 U	6 8 U	0 600 U	0 600 U	0 600 U	0 600 U
Zinc	11,000	--	104	22 4 B	49 7 B	10 5 J	27 3 B	*497*	36	20 5 B	11 7 B	24 4 B	13 7 J	13 5 B	*325*	*311*	10 9 J	21 B	1 90 U	1 90 U

Notes

Exceeds RBC-Tap

Exceeds MCL-Groundwater

Exceeds Background UTL

B - Analyte not detected above associated blank

J - Reported value is estimated

K - Reported value may be biased high

L - Reported value may be biased low

NA - Not Analyzed

ND - Compounds were analyzed but not detected during Background Investigation

NS - Compounds not analyzed during Background Investigation

P - Duplicate sample

U - Analyte not detected

Table 2
Deep Groundwater Exceedances *of* Screening Criteria
at Site 3
St. Juliens Creek Annex
Chesapeake, Virginia

	Screening Criteria										
Station ID	RBC-Tap (10/02)	MCL-Groundwater	BACKGROUND[1]		SJS03-MW01D			SJS03-MW02D			
Sample ID					SJS03-GW1D-001	SJS03-GW1D-002	SJS03-GW1D-003	SJS03-GW2D-001	SJS03-GW2D-002	SJS03-GW2D-003	
Sample Date			Mean	Max	07/24/97	11/04/97	05/19/99	07/24/97	11/04/97	05/19/99	
Chemical Name											
VOCs (UG/L)											
Carbon disulfide	1,000	--	ND	ND	1 U	0.3 J	0.200 J	1 U	1 U	7.60	
Chloroform	0.15	80	ND	ND	0.4 J	1 U	1 U	0.3 J	1 U	1 U	
SVOCs (UG/L)											
bis(2-Ethylhexyl)phthalate	4.8	6	4.0	1	10 U	3 J	12 U	10 U	10 U	1 J	
Pest/PCBs (UG/L)											
No Detections											
Total Metals (UG/L)											
Arsenic	0.045	10	ND	ND	3 U	3.2 U	4.20 J	3 U	3.2 U	2 U	
Barium	2,600	2,000	24.7	32.7	15.8 J	21.7 J	30.7 J	46.6 J	49.1 J	60.2 J	
Calcium	--	--	61,933	75,200	49,300 J	49,500	61,700	103,000 J	95,200	110,000	
Chromium	110	100	ND	ND	7 U	4.6 U	1.40 J	7 U	4.6 U	2.40 J	
Iron	11,000	--	907.7	1,670	788 J	170 B	476	487 J	272	541	
Lead	15	15	ND	ND	1 UL	1.8 J	1 J	2.1 B	1.3 U	1 U	
Magnesium	--	--	6,630	12,000	14,400 J	12,700	16,600	39,000 J	37,100	48,000	
Manganese	730	--	177.7	226	91.3 L	45.6	110	291 L	354	612	
Nickel	730	--	0.7	1.1	8.1 J	6.3 U	0.900 U	7 U	6.3 U	1 J	
Potassium	--	--	4,817	8,490	15,100	15,400	16,600	17,700	16,000	17,600	
Silver	180	--	ND	ND	1 U	1.1 U	0.900 U	1 U	1.2 J	0.900 U	
Sodium	--	--	30,233	39,900	40,600 J	43,300	50,600	37,300 J	34,500	41,000	
Thallium	2.6	2	ND	ND	2.7 J	2.5 B	3.20 UL	2 U	1.5 B	3.20 UL	
Zinc	11,000	--	3.5	4.8	6.4 B	10.9 B	3.80 J	7.1 B	9 B	16.6 J	
Dissolved Metals (UG/L)											
Barium	2,600	2,000	23.0	31.2	14.1 B	20.8 J	23.6 J	42.8 J	53.7 J	58.7 J	
Calcium	--	--	57,667	77,700	53,800 J	51,100	63,700	98,400 J	103,000	105,000	
Iron	11,000	--	788.7	1,360	180 B	130 B	301	156 B	276	464	
Magnesium	--	--	5,967	10,000	18,700 J	13,200	18,000	38,200 J	40,900	46,300	
Manganese	730	--	161.3	188	101 J	46.4	123	284 J	385	583	
Nickel	730	--	1.3	2.3	7 U	6.3 U	0.980 J	7 U	6.3 U	0.900 U	
Potassium	--	--	4,407	7,200	12,600	15,100	17,900	16,600	17,600	18,100	
Sodium	--	--	28,400	37,900	44,100 J	44,800	52,900	35,200 J	37,800	39,600	
Thallium	2.6	2	ND	ND	2.1 J	1.5 U	3.20 U	2 U	1.9 B	3.20 U	
Zinc	11,000	--	6.1	10.5	5 U	5.7 B	4.40 J	7.2 B	18.5 B	10.5 J	

Notes:

Exceeds RBC-Tap

Exceeds MCL-Groundwater

NA - Not Analyzed

B - Analyte not detected above associated blank

Potential human health risk drivers

J - Reported value is estimated

L - Reported value may be biased low

NO - Compounds were analyzed but not detected during Background Investigation

U Analyte not detected

[1] Background UTLs have not been established for deep gorundwater at SJCA The concentrations shown are mean and maximum detected concentrations from sampling conducled at 3 deep monitoring wells in 1999